

Claims

1. Functional element (10) having a longitudinal axis (14), a body section  
5 (16), a hollow piercing section (18), a ring-like contact surface (20) at the body part, which extends substantially perpendicular to the longitudinal axis (14) and radially away from the piercing section (18) and an axially extending ring groove (21) which is provided in the body section radially inside the contact surface (20), with the functional element (10) being designed for attachment to a component (22) which is  
10 of plate-like shape at least in the region of the attachment, in particular to a sheet metal part, wherein the body section (16) has a pressing surface (24) at the side remote from the piercing section and wherein ribs (26) providing security against rotation are provided which cross the ring groove (21) at least in part and wherein the free end of the  
15 piercing section is provided with a ring-like cutting edge (30), characterized in that  
a ring-like bead (32) is provided at the piercing section (18) between the ring-like contact surface (20) and the free end (28) of the piercing  
20 section (18) and in that a ring recess (34) is preferably provided around the piercing section between the bead (32) and the free end face (28) of the piercing section.
2. Functional element in accordance with one of the preceding claims,  
25 characterized in that  
the ring-like cutting edge (30) either projects radially further outwardly than the apex (31) of the bead (32) or projects outwardly to the same extent or projects less far outwardly, i.e. that the diameter of the ring-

like cutting edge (30) is larger than, smaller than or of the same size as the maximum transverse dimension of the bead (32), i.e. as the diameter of an imaginary cylinder (106) on the surface of which the apex (31) of the bead (32) lies.

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3. Functional element in accordance with claim 1 or claim 2, characterized in that the ring groove (21) runs out via an at least substantially conical surface (36) into the ring-like contact surface (20).

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4. Functional element in accordance with any one of the preceding claims, characterized in that the ring-like bead (32) has an at least substantially triangular shape when seen in an axial section plane.

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5. Functional element in accordance with any one of the preceding claims, characterized in that the ring recess (34) extends radially within the ring-like bead (32) and is preferably bounded by the ring-like bead (32) at the side remote from the free end face (28) of the piercing section (18).

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6. Functional element in accordance with any one of the preceding claims, characterized in that the ring recess (34) is at least substantially U-shaped when seen in an

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axial section plane and preferably has at least substantially the shape of a semi-circle.

7. Functional element in accordance with claim 7,

5 characterized in that

it is formed as a hollow fastener element and has a fastener section (13) provided for the reception of a bolt.

8. Functional element in accordance with one of the preceding claims,

10 characterized in that

the body section (16) has a flange section (40), with the ring-like contact surface (20) and the axially extending ring groove (21) being provided at or in the flange section (40) at its side facing the piercing section (18).

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9. Functional element in accordance with claim 8,

characterized in that

the fastener section (13) has one of the following designs:

20 a) it is located at the side of the flange section (40) remote from the piercing section (18),

b) it is located at the side of the flange section (40) remote from the piercing section (18) and extends at least partly into the flange section (40),

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c) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40),

5        d) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40) and also through a part of the axial length of the piercing section (18),

10       e) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40) and also through the total axial length of the piercing section (18),

15       f) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends through a part of the axial thickness of the flange section (40) and also through a part of the total axial length of the piercing section (18),

20       g) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through a part of the axial thickness of the flange section (40) and also through the total axial length of the piercing section (40),

25       h) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends only through the total axial length of the piercing section (18),

i) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends only through a part of the total axial length of the piercing section (18).

- 5    10.    Functional element in accordance with one of the preceding claims,  
characterized in that  
the ring-like cutting edge (30) at the free end of the piercing section  
(18) forms the transition between a cylinder surface (56) at the outer  
side of the piercing section (18) and a ring-like end face (54) of the  
10    piercing section (18).
11.    Functional element in accordance with claim 10,  
characterized in that  
the cylinder surface (56) is a cylinder surface of a circular cylinder.  
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12.    Functional element in accordance with claim 10 or claim 11,  
characterized in that  
a ring-like discontinuity is located between the cylinder surface (56)  
and the U-shaped ring recess (34).  
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13.    Functional element in accordance with one of the claims 1 to 9,  
characterized in that  
the ring-like cutting edge (30) at the free end of the piercing section  
(18) forms the transition between a conical surface tapering in the di-  
25    rection of the flange section at the outer side of the piercing section  
(18) and a ring-like end face (54) of the piercing section (18).

14. Functional element in accordance with claim 13,  
characterized in that  
a ring-like discontinuity is located between the conical surface and the  
U-shaped ring recess (34).

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15. Functional element in accordance with claim 13,  
characterized in that  
the conical surface tapering in the direction of the flange section  
merges continuously without discontinuity into the U-shaped ring re-  
cess (34).

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16. Functional element in accordance with one of the preceding claims,  
characterized in that  
the axial length between the apex point (31) for the bead (32) and the  
free end face (28) of the piercing section (18) lies in the range between  
1 and 4 mm.

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17. Functional element in accordance with one of the preceding claims,  
characterized in that  
the axial spacing between the apex point (31) of the bead (32) and the  
ring-like portion (20) of the contact surface which lies in a plane per-  
pendicular to the longitudinal axis (14) lies in the range between 0.2  
and 2 mm.

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- 25 18. Functional element in accordance with one of the preceding claims,  
characterized in that  
the radial depth of the ring recess (34) measured from the apex point  
(31) of the bead (32) lies in the range between 0.5 and 2 mm.

19. Functional element in accordance with claim 10 or claim 11,  
characterized in that  
the axial length of the cylinder surface (56) amounts to 0.3 to 2 mm.

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20. Functional element in accordance with claim 13,  
characterized in that  
the axial length of the conical surface amounts to 0.3 to 2 mm.

- 10 21. Functional element in accordance with one of the preceding claims,  
characterized in that  
ribs (26) providing security against rotation are provided in the ring  
groove (21).

- 15 22. Functional element in accordance with one of the preceding claims,  
characterized in that  
the base surface of the ring groove (21) is provided on at least a part of  
its radially extent with noses (26) providing security against rotation  
and/or with grooves (84) providing security against rotation.

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23. Functional element in accordance with one of the preceding claims,  
characterized in that  
ribs (26) providing security against rotation are provided which bridge  
the peripherally extending ring groove (21).

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24. Functional element in accordance with one of claims 21 to 23,  
characterized in that  
ribs (26) providing security against rotation or noses providing security

against rotation do not project in the axial direction beyond the ring-like section (20) of the contact surface which lies in a plane perpendicular to the longitudinal axis and are preferably set back slightly relative to the latter.

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25. Functional element in accordance with one of the preceding claims, characterized in that

ribs (26) providing security against rotation are provided which extend in raised manner within the ring groove (21) in the axial direction up to the bead (32), i.e. at least substantially have a rectangular shape with two limbs.

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26. Functional element in accordance with claim 25, characterized in that

the axially extending sections (26') of the ribs (26) providing security against rotation do not project in the radial direction beyond the apex point (31) of the bead (32) and are preferably set back slightly radially with respect to the apex point (31).

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27. Functional element in accordance with claim 1, characterized in that

the piercing section is formed in the region below the bead (32) in cylindrical manner without ring recess (Fig. 5).

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28. Functional element in accordance with one of the preceding claims, characterized in that

the ring-like bead (32) has the form of at least one turn of a thread.

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29. Functional element in accordance with one of the claims 1 to 27,  
characterized in that  
the bead (32) has the form of at least two sections (32', 32'') of a turn of  
a thread.

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30. Functional element in accordance with one of the claims 1 to 27,  
characterized in that  
the bead (32) has the form of sections (32', 32'') of a turn of a left hand  
thread and of a turn of a right hand thread which are alternately ar-  
ranged around the longitudinal axis (14).

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31. Functional element in accordance with claim 30,  
characterized in that  
the turn sections (32', 32'') are connected to one another and prefera-  
bly form a closed ring.

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32. Functional element in accordance with claim 31,  
characterized in that  
in total four turn sections (32', 32'') are provided.

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33. Functional element in accordance with one of the claims 25 to 26,  
characterized in that  
the axial sections (26') of the ribs (26) providing security against rota-  
tion are of different length.

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34. Component assembly comprising a sheet metal part (22) and at least  
one functional element (24) with a longitudinal axis (14), with a body  
section (16), a hollow piercing section (18), a ring-like contact surface

(20) at the body part, which extends substantially perpendicular to the longitudinal axis (14) and radially away from the piercing section (18) and an axially extending ring groove (21) which is provided in the body section radially inside the contact surface (20), with the functional  
 5 element being designed for attachment to a component (22) which is of plate-like shape at least in the region of the attachment, in particular to a sheet metal part, wherein the body section has a pressing surface (24) at the side remote from the piercing section and wherein ribs (26) providing security against rotation are provided which cross the ring  
 10 groove (21) at least in part and wherein the free end (28) of the piercing section (18) is provided with a ring-like cutting edge (30), characterized in that

a ring-like bead (32) is provided at the piercing section (18) between the ring-like contact surface (20) and the free end (28) of the piercing  
 15 section (18); in that a ring recess (34) is preferably provided around the piercing section between the bead (32) and the free end face (28) of the piercing section (18);

in that material of the sheet metal part (22) contacts the contact surface (20) and at least substantially fills out the ring groove (21) and in  
 20 that the sheet metal part has a piercing in the region of the piercing section through which the piercing section (18) extends, with the bead (32) being received in a ring-like groove (90) in the marginal zone of the piercing.

- 25 35. Component assembly in accordance with claim 34, characterized in that  
 the sheet metal part (22) has a ring-like recess (88) around the piercing and at the side remote from the contact surface (20).

36. Component assembly in accordance with claim 34,  
characterized in that  
the sheet metal part (22) has a ring-like projection (86) around the  
piercing and at the side remote from the contact surface (20), with the  
ring-like projection at least partly surrounding the bead (32) and in  
that a ring-like recess (90) surrounds the ring-like projection (86).
37. Component assembly in accordance with claim 35 or claim 36,  
characterized in that  
the ring-like recess (90) in the sheet metal part is surrounded by a  
planar surface (96) which lies in a plane perpendicular to the longitu-  
dinal axis (14) of the fastener element.
38. Component assembly in accordance with claim 37,  
characterized in that  
the body section (16) has a flange section (40) with the ring-like contact  
surface (20) and the axially extending ring groove (21) being provided  
at or in the flange section (40) at its side facing the piercing section  
(18) and in that the planar surface (96) lies at least partly opposite to  
the flange section (40) and to the ring-like contact surface (20).
39. Component assembly in accordance with one of the claims 34 to 38,  
characterized in that  
the ring groove (21) extends radially within the ring-like bead (32) or is  
bounded at the piercing section side by the ring-like bead (32) and in  
that the sheet metal material part also fills out this region of the ring  
groove (21).

40. Component assembly in accordance with claim 39,  
characterized in that,  
in the region radially within the ring-like bead (32), the ring groove (21)  
5 has at least substantially the shape of the semi-circle in an axial section plane.

41. Component assembly in accordance with one of the claims 34 to 40,  
characterized in that  
10 the ring bead (32) has an at least substantially triangular shape in an axial section plane and in that the ring-like groove (90) has the same shape in the marginal zone of the piercing.

42. Component assembly in accordance with claim 34 to 41, wherein the  
15 fastener element is formed as a hollow fastener element (10) and has a fastener section (13) provided for the reception of a bolt,  
characterized in that:

20 a) it is located at the side of the flange section (40) remote from the piercing section (18),

b) it is located at the side of the flange section (40) remote from the piercing section (18) and extends at least partly into the flange section (40),

25 c) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40),

d) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40) and also through a part of the axial length of the piercing section (18),

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e) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through the total axial thickness of the flange section (40) and also through the total axial length of the piercing section (18),

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f) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends through a part of the axial thickness of the flange section (40) and also through a part of the total axial length of the piercing section (18),

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g) it is located at the side of the flange section (40) remote from the piercing section (18) and extends through a part of the axial thickness of the flange section (40) and also through the total axial length of the piercing section (40),

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h) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends only through the total axial length of the piercing section (18),

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i) it is located at the side of the flange section (40) adjacent the piercing section (18) and extends only through a part of the total axial length of the piercing section (18).

43. Component assembly in accordance with one of the preceding claims,  
characterized in that  
the ring recess (34), when considered in an axial section plane, has at  
5 least substantially the shape of a semi-circle and in that the sheet  
metal material at least partly fills out the ring recess.
44. Component assembly in accordance with one of the claims 34 to 43,  
characterized in that  
10 the ribs (26) providing security against rotation extend in raised man-  
ner within the ring groove (21) in the axial direction up to the bead, i.e.  
have an at least substantially rectangular shape with two limbs and in  
that the sheet metal material is formed around the two limbs of the  
ribs providing security against rotation.
- 15 45. Component assembly in accordance with claim 44,  
characterized in that  
the axially extending sections (26') of the ribs providing security  
against rotation do not project in the radial direction beyond the apex  
20 (31) of the bead (32) and are preferably arranged set back slightly ra-  
dially relative to the apex.
46. Component assembly in accordance with one of the claims 34 to 45,  
characterized in that  
25 the axially extending sections (26') of the ribs (26) providing security  
against rotation do not project in the axial direction beyond the ring-  
like contact surface (20) or only fractionally beyond the ring-like con-  
tact surface (20).

47. Component assembly in accordance with one of the claims 34 to 46,  
characterized in that  
the ring-like bead (32) has the shape of at least one turn of a thread.
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48. Component assembly in accordance with one of the preceding claims  
34 to 46,  
characterized in that  
the ring-like bead (32) has the shape of at least two sections (32', 32'')  
of one turn of a thread.
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49. Component assembly in accordance with one of the preceding claims  
34 to 46,  
characterized in that  
the bead (32) has the form of sections (32', 32'') of a turn of a left hand  
thread and of a turn of a right hand thread which are alternately ar-  
ranged around the longitudinal axis (14).
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50. Component assembly in accordance with claim 49,  
characterized in that  
the turn sections (32', 32'') are connected to one another and prefera-  
bly form a closed ring.
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51. Component assembly in accordance with claim 50,  
characterized in that  
a total of four turn sections (32', 32'') are provided.
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52. Component assembly in accordance with claim 45 and one of the claims 47 to 51,  
characterized in that  
the axial sections (26') of the ribs providing security against rotation  
are of different length.

53. Method for the manufacture of a component assembly in accordance with one or more of the claims 34 to 52,  
characterized by the following steps:

a) the sheet metal part is supported on a die button which has a bore having a diameter which is designed to receive the ring-like piercing edge of the fastener element, with the bore of the die button being surrounded by a ring projection which merges at the side radially remote from the bore into a surface perpendicular to the longitudinal axis of the bore, with the longitudinal axis of the bore being at least substantially aligned with the longitudinal axis of the fastener element,

b) the fastener element is moved in the direction towards the sheet metal part and the die button lying beneath it and a piercing slug is removed from the sheet metal part by the ring-like cutting edge, with the piercing slug being received by the bore of the die button or disposed of through it,

c) at the same time as the cutting out of the piercing slug or thereafter, the sheet metal material is shaped by the movement of the body part towards the sheet metal part and the die button by means of the ring projection into the ring groove and around the bead in order to pro-



duce a form-locked connection between the sheet metal part and the fastener element.

54. Method in accordance with claim 53,  
5 characterized in that,

on the shaping of the sheet metal material by the ring projection, the sheet metal material is also formed around or into the features providing security against rotation, i.e. the ribs providing security against rotation.

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55. Method in accordance with one of the claims 53 or 54,  
characterized in that

the sheet metal material in the region of the fastener element radially outside of a recess caused by the ring projection is pressed flat by the  
15 said surface of the die button which stands perpendicular to the longitudinal axis.

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56. Method in accordance with one of the preceding claims 53 to 55,  
characterized in that

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the sheet metal material is shaped into a ring collar surrounding the bead.

57. Method for the manufacture by cold forming of a functional element, in particular of a functional element in accordance with one of the claims  
25 1 to 33, the functional element having a longitudinal axis, a body section, a hollow piercing section, a ring-like contact surface at the body part, which extends substantially perpendicular to the longitudinal axis and radially away from the piercing section and an axially extend-

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ing ring groove which is provided in the body section radially inside the contact surface, wherein the body section has a pressing surface at the side remote from the piercing section and wherein ribs providing security against rotation are provided which cross the ring groove at least  
5 in part and wherein the free end of the piercing section is provided with a ring-like cutting edge, wherein a ring-like bead is provided at the piercing section between the ring-like contact surface and the free end of the piercing section wherein a ring recess is preferably provided around the piercing section between the bead and the free end face of  
10 the piercing section,  
characterized by the following cold forming steps:

a) an initially cylindrical blank is made in one or more steps into a blank for the functional element with the end face of the cylindrical  
15 portion and also the opposite end of the blank each being indented to form respective indents and the body part with the ring groove and a cylindrical section, which is later shaped into the piercing section, and also optionally features providing security against rotation being produced in the region of the ring groove and/or at the cylindrical section,  
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b) material adjacent to the end face of the cylindrical section is shifted in the direction towards the ring-like groove to form the ring-like bead while reducing the outer diameter of the cylindrical section in the region of its end face, wherein, on the formation of the bead in the form  
25 of a turn of a thread or of a plurality of sections of a thread, the ribs providing security against rotation are also shaped at their free ends,

c) in a further step, the end face of the functional element is deformed and enlarged in diameter in order to form the cutting edge at the end face of the cylindrical section and a ring groove around the cylindrical section between the end face of the cylindrical section and the bead,

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d) the thus finished manufactured blank is subsequently pierced or is simultaneously pierced by means of a hole punch in the region between the two indents and, if desired, the pierced region is subsequently provided with a thread.

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